

A Plug and Play Joint Test Environment for Future Operational Testing

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ABSTRACT

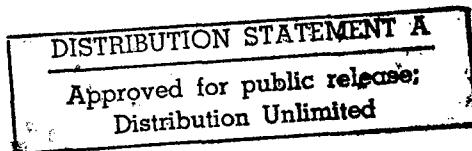
The End-To-End (ETE) Test, conducted under the auspices of the Department of Defense Joint Advanced Distributed Simulation (JADS) Joint Test and Evaluation (JT&E), is currently developing a synthetic test environment that can be used for future operational testing and doctrinal development. This synthetic test environment is a joint venture, involving both the ETE and the US Army's Test and Experimentation Command (TEXCOM), and will be used initially to conduct operational testing of the Joint Surveillance Target Attack Radar System (Joint STARS) and future C4ISR systems. The test environment will be the result of the merging of two advanced distributed simulation (ADS) environments that consist of live elements, hardware in the loop, DIS compliant simulations, and constructive legacy models. The ADS environments involved are the ETE Joint STARS Target Attack Environment and the Simulation Test Operational, Rehearsal Model (STORM) Environment.

The plug and play aspects of this Joint Test Environment are best illustrated by current discussions with the US Air Force regarding the addition of an Air Force Target Exploitation Environment. Addition of this environment would allow the investigation of doctrinal issues of interest to both the Air Force and the Army, and further operational testing of Joint STARS. Additionally, the elements comprising the nodes may be represented by simulations or by the actual system, since all of the communication is doctrinally correct and may be passed using actual communications systems. As an example, the Improved Army Tactical Missile System could replace the currently simulated Army Tactical Missile System and operational testing could be rehearsed and conducted using a variety of operational and doctrinal schema. This paper describes the architecture of the Joint Test Environment, current developmental efforts, and potential future expansions and uses of the environment.

Background

The Joint Advanced Distributed Simulation (JADS) Joint Test and Evaluation (JT&E) has been chartered by the Office of the Under Secretary of Defense (Acquisition and Technology), Office of the Director, Test and Evaluation "...to investigate the utility of

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Advanced Distributed Simulation (ADS) for both developmental test and evaluation (DT&E) and operational test and evaluation (OT&E). JADS will investigate the present utility of ADS, including Distributed Interactive Simulation, for T&E; and finally, identify the requirements that must be introduced in ADS systems if they are to support a more complete T&E capability in the future.”

The approach taken by JADS was to select discrete, well-defined, slices of the broad T&E spectrum, conduct ADS augmented test activities upon specific systems that are representative of these slices, and address the issues identified within our charter. In addition, ADS activity external to JADS will be evaluated to provide as broad a base for our conclusions as is possible.

The emphasis of the JADS JT&E is on the performance of the ADS components and their contribution to testing, rather than any particular system under test or class of weapon system. Areas of interest include network capabilities and performance, relationships between data latencies, and ADS induced data anomalies.

The End-To-End (ETE) Test is one of three tests within the JADS JT&E program. The ETE is designed to evaluate the utility of ADS to support the testing of a C4ISR system, the Joint Surveillance Target Attack Radar System (Joint STARS), while the system performs the end-to-end loop of detect, track, target, cue a weapons system, and assess battle damage. Joint STARS is composed of both an airborne and ground segment along with the necessary communications subsystems. The E-8 airborne system and the Common Ground Station (CGS) together provide the surveillance, target detection, and tracking required to assist commanders in understanding the enemy situation and taking action to destroy enemy forces.

A previous shortfall in the testing of C4ISR systems, especially those using large area sensor systems such as Joint STARS, was the inadequate numbers of forces, either friendly or adversary, available to realistically portray the expected operational environment. In addition, systems were often tested in isolation without the complementary suite of other C4ISR and weapon systems with which to interact. The ETE Test is designed to add an augmented operational environment and a complementary suite of C4ISR and weapons systems with which Joint STARS would interact to determine if ADS can alleviate these testing shortfalls.

In addition, the ETE Test utilizes the technology specified by the Electrical and Electronics Engineers (IEEE) 1278 Standard, known as Distributed Interactive Simulation (DIS). This standard specifies a distributed communication architecture, defines protocol data units (PDU) that carry information between the nodes of the distributed simulation, provides common enumeration values for use within the PDUs, and most importantly, provides a common interface into the distributed simulation that allows its reuse.

JADS ETE Target Attack Environment

The JADS ETE Target Attack Environment is composed of two synthetic sub-environments (SSE). The first sub-environment, called the Sensor SSE, represents Joint STARS. The second sub-environment represents some of the components of the Army's C4ISR system and the Army Tactical Missile System (ATACMS). This sub-environment will be referred to as the C4ISR-ATACMS SSE. The sub-environments share two common components, the simulation(s) that provides the battlefield environment and the Ground Station Module (GSM) or Common Ground Station (CGS).

The Sensor SSE, consists of the simulation(s) that provides the battlefield environment, the simulation of the sensor system aboard the E-8C, E-8C components or simulations, and the GSM or CGS. The GSM or CGS is the Army's portion of the Joint STARS and is linked into the Army C4ISR system. The C4ISR-ATACMS SSE consists of the simulation(s) that provides the battlefield environment; the Corps Analysis and Control Element (ACE), which uses the All Source Analysis System (ASAS); a simulation of the Army's Advanced Tactical Missile System (ATACMS) and a corps-level fire control element (FCE); and the GSM or CGS. Figure 1 illustrates these two SSEs and their intersection.

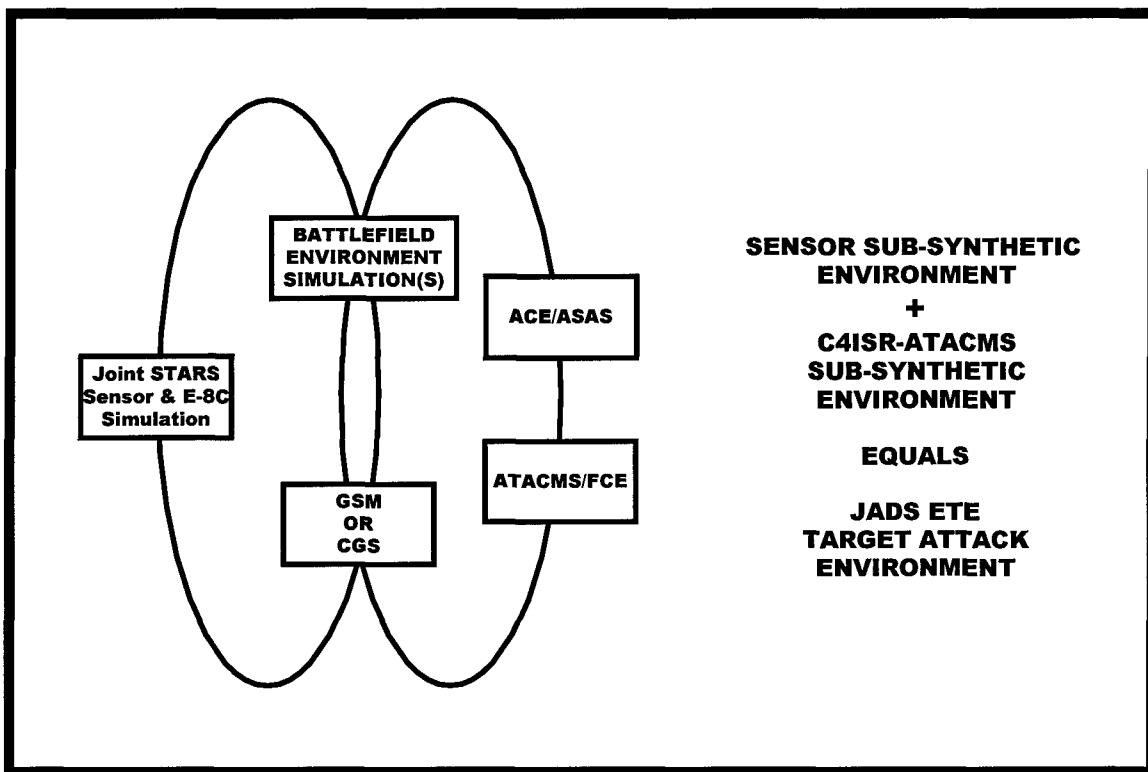


Figure 1

Taken as a whole, and when properly verified and validated, the JADS ETE Target Attack Environment enables testers to investigate many of the facets of the end-to-end loop of detect, track, target, cue a weapons system, and assess battle damage using Joint STARS and ATACMS.

As an example of the plug and play aspects of this environment, the elements comprising the nodes may be represented by the actual system, since all of the communication is doctrinally correct and may be passed using actual communications systems. For example, the Improved Army Tactical Missile System could replace the currently simulated Army Tactical Missile System and operational testing could be rehearsed and conducted using a variety of operational and doctrinal schema. It should be emphasized, however, that each version of the Plug and Play Joint Test Environment must be tested, verified, validated and accredited by the tester for use in the particular test for which it is designed.

Within the JADS ETE Test, this environment will be used to supplement the operational environment the Joint STARS E-8C radar normally experiences. By mixing available live targets with targets generated by the simulation(s) within the JADS ETE Target Attack Environment, a battle array that approximates the major systems present in a corps area-of-interest can be presented and used for targeting for attack by ATACMS. This operationally enhanced environment will enable the operational testing of Joint STARS under conditions more closely approximating actual combat.

STORM Synthetic Test Environment

It was recognized early in the life of the ETE Test that the representation of the C4ISR-ATACMS SSE lacked robustness, and could be greatly improved by bringing into the environment representations of additional corps level intelligence assets. At the same time, a concept for an analysis and training support tool kit was under development by the Test and Experimentation Command (TEXCOM), under the auspices of the US Army Operational Test and Evaluation Command. This concept, initially known as Force XXI Operations Rehearsal Test Support (FORTS), is now known as Simulation Testing Operations Rehearsal Model (STORM).

STORM is an analysis and training tool kit that can be used for test preparation, test execution, post test analysis, and operations training and enhancement studies involving C4ISR systems. It will provide scenario generation capability using linked Corps Battle Simulation (CBS) and DIS and Appliqué capable Janus(s), a C4ISR environment through the database population via CBS of the Army Tactical Command and Control System (ATCCS) Simulation Support Modules (SSM), test stimulation through the creation of a battlefield synthetic environment, and test visualization.

STORM is designed with the capability to be tailored into federations to meet the requirements of each C4ISR system it is to be used with, and can be used with more than one system at a time, allowing multiple testing with limited assets. An example of a proposed federation for the testing of the Force XXI Battle Command Brigade and Below system is shown at Figure 2.

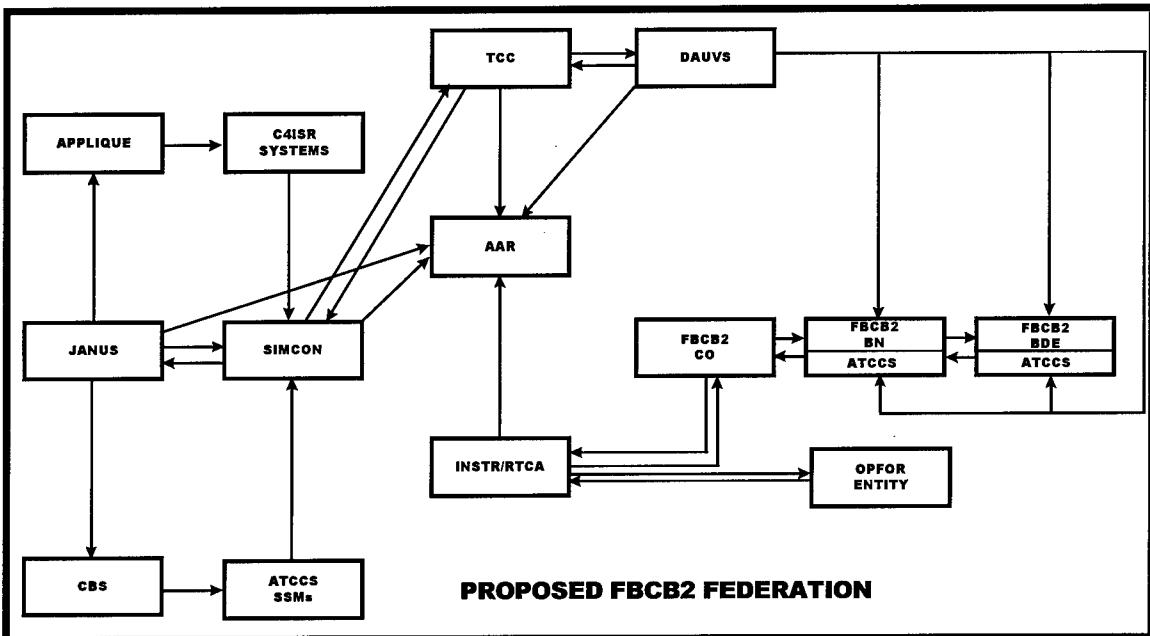


Figure 2

Plug and Play Joint Test Environment

The Plug and Play Joint Test Environment is a result of an agreement between JADS and TEXCOM to merge the JADS ETE Target Attack Environment with STORM. This merger allows JADS and TEXCOM to share mutually required resources, allows TEXCOM access to a major C4ISR resource, Joint STARS, and allows JADS access to the corps level C4ISR assets provided by STORM.

The plug and play aspect of this merger is brought about by the distributed nature of the two tests and the use of distributed interactive simulation standards when distributed elements of the environment are communicating with each other. At present, IEEE DIS standard is used, but provisions have been made to convert to HLA once it is implemented within the simulation community.

Restrictions on entering the Plug and Play Joint Test Environment are few and relatively simple. Obviously, if one wants to participate, one must be willing to use, or interact with, the theater of war and the master scenario that the test participants have agreed upon for a particular test event. Secondly, one must not interfere with the other test participants.

As an example, JADS intends to fly several virtual and real Joint STARS missions as a part of the ETE Test. Other test participants within the Plug and Play Joint Test Environment may use the results of the missions, and even interact with the E-8C in a doctrinally correct manner, provided they have previously coordinated with JADS. They cannot have a say in what orbits the E-8C will fly nor what the intelligence priorities will be for the mission. They can however, make their needs known, and would most likely be accommodated on a non-interference basis.

Lastly, all participants in the Plug and Play Joint Test Environment must pay their own way. This includes not only what they bring to the environment, but also any approved changes to the environment that they need.

In addition to these restrictions, it must also be understood that the modified environment must be tested to ensure that it still satisfies the needs of the original users, along with the needs of the user joining the environment, and verified, validated, and accredited by each tester prior to use.

By its very nature, the Plug and Play Joint Test Environment is constantly evolving until it undergoes verification, validation and accreditation (VV&A) prior to being used for an actual test event. The currently planned environment that will be used for the STORM/FBCB2 Alpha Test 2 and the JADS ETE Early Assessment Operational Test is shown at Figure 3.

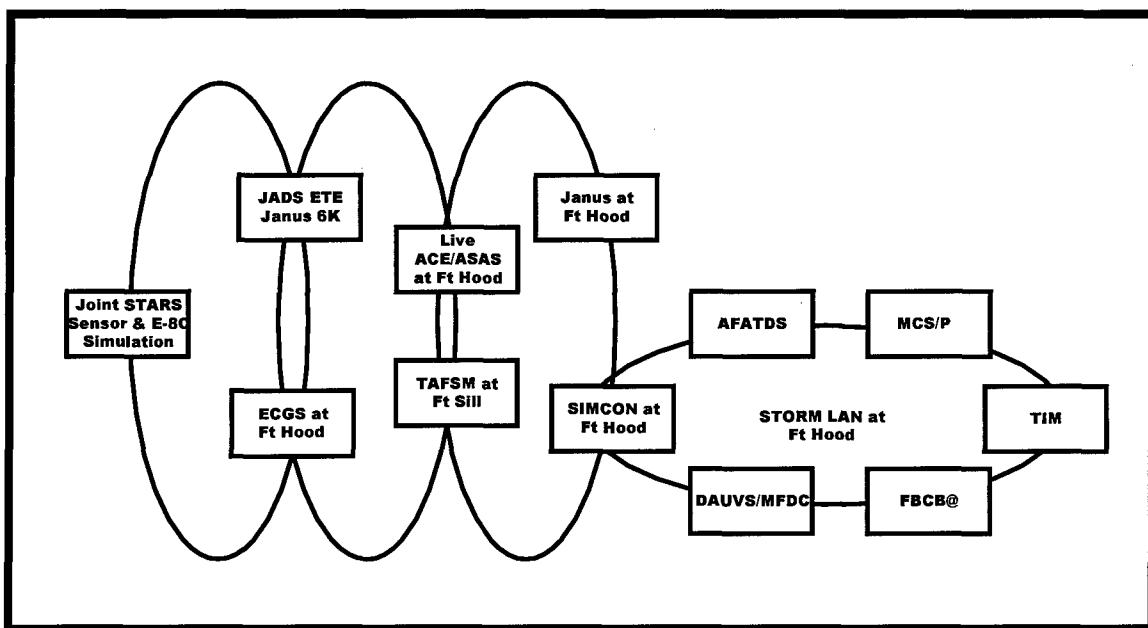


Figure 3

As can be easily seen, we have simply plugged the STORM environment into the JADS ETE environment, or the JADS ETE environment into the STORM environment. All interactions between the environments are through the use of DIS protocol data units (PDUs) or intra-system communication links.

The Future of the Plug and Play Joint Test Environment

The future of the Plug and Play Joint Test Environment is here and now. Current plans call for the modification and use of the environment to conduct JADS ETE test events and TEXCOM test events in April of 1999. This will require bringing a real E-8C into the environment on the JADS side and the systems that TEXCOM wishes to test on the TEXCOM side. These TEXCOM systems can be any corps level or below system currently under development. In addition, live units will take part in the test and will be

plugged into the environment at the appropriate locations. In addition, the 504th Military Intelligence Brigade at Ft Hood, Texas, having recognized the opportunity for some excellent training, will activate actual III Corps C4ISR elements during parts of the two week test period. These units will be able to receive data from the Plug and Play Joint Test Environment and conduct training, using the data, parallel to the tests being conducted. In some cases, they will even be able to interact with the Plug and Play Joint Test Environment in a non-interfering manner.

In addition, discussions are currently underway with US Air Force elements on the potential for adding an Air Force Target Exploitation Environment to the Plug and Play Joint Test Environment. Addition of this environment will allow the investigation of doctrinal issues of interest to both the Army and the Air Force, and would enable the two Services to conduct simultaneous testing, training, and doctrinal development in an environment that would be as real, or virtual, as the particular event being conducted required. An example of how this environment might be constructed is shown in Figure 4.

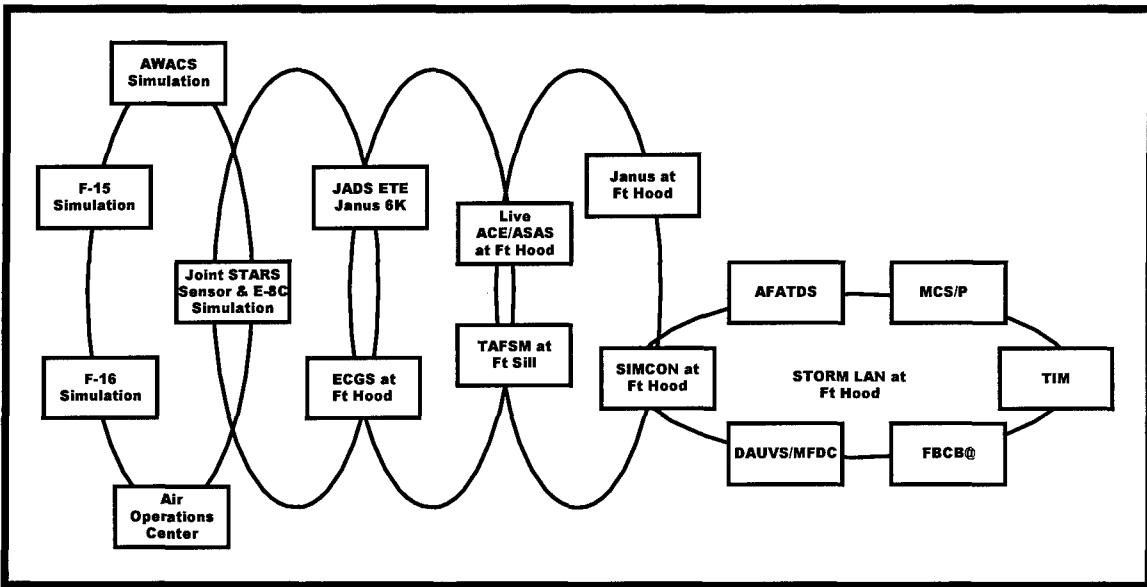


Figure 4

Not shown within Figure 4 are the many communications links that would be required. These links could be either real or virtual depending upon the way the environment was configured. Also, the Air Force could add additional environments to the Plug and Play Joint Test Environment that connected to either the Air Force environment or the Army environment.

Summary and Conclusions

JADS and TEXCOM have developed a Plug and Play Joint Test Environment that may be easily reconfigured to accommodate the operational testing of weapon and C4ISR systems. The only requirements are that someone entering the environment uses distributed interactive simulation standards or intra-system communications when distributed elements of the environment are communicating with each other, they must be

willing to use, or interact with, the theater of war and the master scenario that the test participants have agreed upon for a particular test event, they must not interfere with the other test participants, and they must pay for their requirements. Finally, it must be understood that any change to the environment requires additional testing, verification, and validation followed by accreditation of the environment by the tester. This Plug and Play Joint Test Environment has tremendous potential for future Joint operational testing, training, and doctrine development.

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